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ABSTRACT

A brief introduction to developmental efforts in computer assisted instruction (CAI) at Pennsylvania State University is followed by a description of a program of mobile CAI facilities inaugurated in 1970 as part of the inservice continuing education program for teachers. The paper includes very brief descriptions of the graduate level courses included in the system, the actual physical facilities used for the mobile project, and the current implementation schedule that is being used. Finally there is a short section on curricular compatibility and another on systems compatibility or convertability, in which some special applications programs which provide documentation and eliminate the need for coding curriculum material in special computer languages are described. (WDR)

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CURRICULAR AND COMPUTER SYSTEM COMPATIBILITY OF CAI PROGRAMS FOR MULTI-UNIVERSITY USE

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Since 1964 computer-assisted instruction has been used at Penn State as a means of providing inservice training for teachers widely disbursed throughout the state. The developmental efforts have been focused on stand-alone courses to provide the complete program of instruction equivalent to certain college courses. The stand-alone concept was adapted for two reasons: 1) to meet the needs of the widely disbursed audience without having a professor on site; and 2) to provide CAI as a direct replacement in function as well as cost rather than being an add-on cost to an existing instructional program.

The early work of the Laboratory was done using typewriter terminals to which random access slides and random access audio tapes were eventually added. In 1967 the first production line IBM 1500 system was installed at Penn State and that configuration has been used since then. In October of 1970 a program of mobile computer-assisted instruction (CAI) was inaugerated in the inservice continuing education program for teachers.*

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*The operation of the mobile system is currently supported by the University, the Penn State Foundation, and a grant from the National Center for the Improvement of Educational Systems of the United States Office of Education. The development of the CARE courses for computer presentation is funded by a grant from the Bureau of Education for the Handicapped, United States Office of Education. Alternative strategies and a cost benefit comparison for providing inservice instruction for teachers are described in Hall and Mitzel (1973).

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Curriculum

The graduate level courses developed or being developed are designed to assist teachers in understanding, identifying, and remediating the problems of handicapped children. The courses all bear the generic title CARE or Computer Assisted Renewal Education. The major objective of the CARE series is to teach inservice teachers, aides, and other educators how to work effectively with handicapped children in typical classrooms. The courses were developed by a team of faculty members under the leadership of Professors G. Phillip Cartwright and Carol A. Cartwright (Cartwright and Cartwright, 1973). The students interact with the instructional program at computer student stations. In addition to the program of instruction stored in the computer, each student uses a textbook, a handbook, and a set of materials for testing young children. When the teacher-student completes this course, he or she takes a 75-item final examination generated by the computer from a pool of more than 300 test questions covering the objectives of the course. A complete record of each participant's performance, not only on the test but on the course as well, is recorded on magnetic computer tape for summarization, marking and course improvement. Teacher-students are awarded marks by the faculty member in charge of the course, and they receive credit appropriate to the amount of curriculum included in the program.

Facilities

To implement this program, a custon-built expandable van was fitted with a small, stand-alone computer and 16 student stations (IBM 1500 Instructional System). Each student station is equipped with a small

cathode-ray tube (CRT) on which is displayed alphameric information plus a wide variety of graphics, including animated illustrations. Student response components of the CRT include a typewriter-like keyboard with upper and lower case characters plus a variety of special characters, and a light-sensitive pen used by the learner in making responses to displayed material. In addition to the CRT, each student station has a rear-screen image projector on which are displayed color photographic images from a 1,000-frame, 16mm film with each frame randomly accessible by the computer at a search rate of 40 frames per second. The third display component is an individual audio play/record device with randomly accessed prerecorded messages on 1/4-inch audiotape.

Implementation

On a prearranged schedule, the mobile CAI laboratory is moved to a school in a rural community and connected to electric, telephone and water services. Over the next seven weeks, in late afternoon and evening hours, elementary teachers and their supervisors schedule themselves for one- to three-hour sessions at computer student stations on flexible and irregular schedules to fit into the demands of their personal lives. During a seven-week period the laboratory will accommodate from 125 to 150 learners who enroll for a typical three-credit college course. The students, of course, put in considerable time in home study of the textbook and the 400-page handbook which accompany the course. Currently the existing curriculum, student stations, and relocation every six weeks meet the needs of a target audience in a 25-mile radius.

The field staff for the program consists of a manager who travels with the mobile laboratory, plus a computer operator and two student proctors hired in the local community to help students with scheduling and student station operations. The faculty member in charge of the course is available from time to time to talk with students in person and can always be reached by telephone.

Curricular Compatibility

The CARE programs have been offered for credit by nine different institutions (5 via Penn State Mobile CAI systems and 4 via their own CAI systems) in addition to Penn State. These institutions and the enrollment at each institution for the CARE courses are shown in Table 1. The extent to which the curriculum has been accepted by other institutions is a direct result of the efforts of the development team. During the development of the courses the curriculum was being continuously reviewed by faculty members from other institutions (not necessarily those where the credit was eventually offered for the program) to insure a broad perspective of the curriculum concepts and to insure that the course was abreast of the current trends and patterns throughout the United States.

Systems Compatibility
or Convertibility

The key factor in the compatibility of course materials with several systems lies in the capabilities and functions of the student station devices. If student station devices are functionally equivalent on two

Table 1

Student Enrollment Summary for CARE Courses

Institution	Registrants	Credit Hours
Penn State University		
On-Campus	1230	3648
Off-Campus	1688	5064
University of Houston	210	630
Georgia State University	81	243
Southern Illinois University - Edwardsville	126	378
Northern Illinois University - DeKalb	180	540
Indiana University	99	297
University of Texas - Austin	*	
SUNY - Stony Brook	*	
University of Alberta - Edmonton	*	
Montgomery County Public Schools - Maryland	*	
Total	3614	10,800

*Implemented on their system and therefore data is not readily available.

systems the curriculum can be converted very easily requiring only programming modifications and clerical support to make the conversion. However, if the functional characteristics (e.g., typewriter vs. graphics CRT or photographic image display vs. none) of the student station are drastically dissimilar, educational and instructional decisions will be required to determine new methods and techniques for restructuring the curriculum.

Part of the effort at Penn State has been to develop techniques which will provide a computer-system free and computer-langauge free documentation of the curriculum. One application program not only provides documentation as a by-product but eliminates the need for coding curriculum material in any computer language. TACL (Teaching and Coursewriting Language) enables authors to develop their curriculum content without knowing any computer language at all (Countermine, 1973). After they have written their material on specified forms it is input in the computer system using an on-line CRT, compiled by the operating system, and then made available to the author and students for testing and evaluation. Samples of the author's writing (Figure 1), Coursewriter II Program generated by TACL (Figure 2), and TACL source listing (Figure 3) are included. A natural extension of TACL would be modifications to produce Coursewriter III (IBM 360/370 Systems), Tutor (PLATO System) and other CAI languages as they become available.

At this stage of development in CAI it seems that curricula compatibility among institutions and machine readable documentation to facilitate conversion

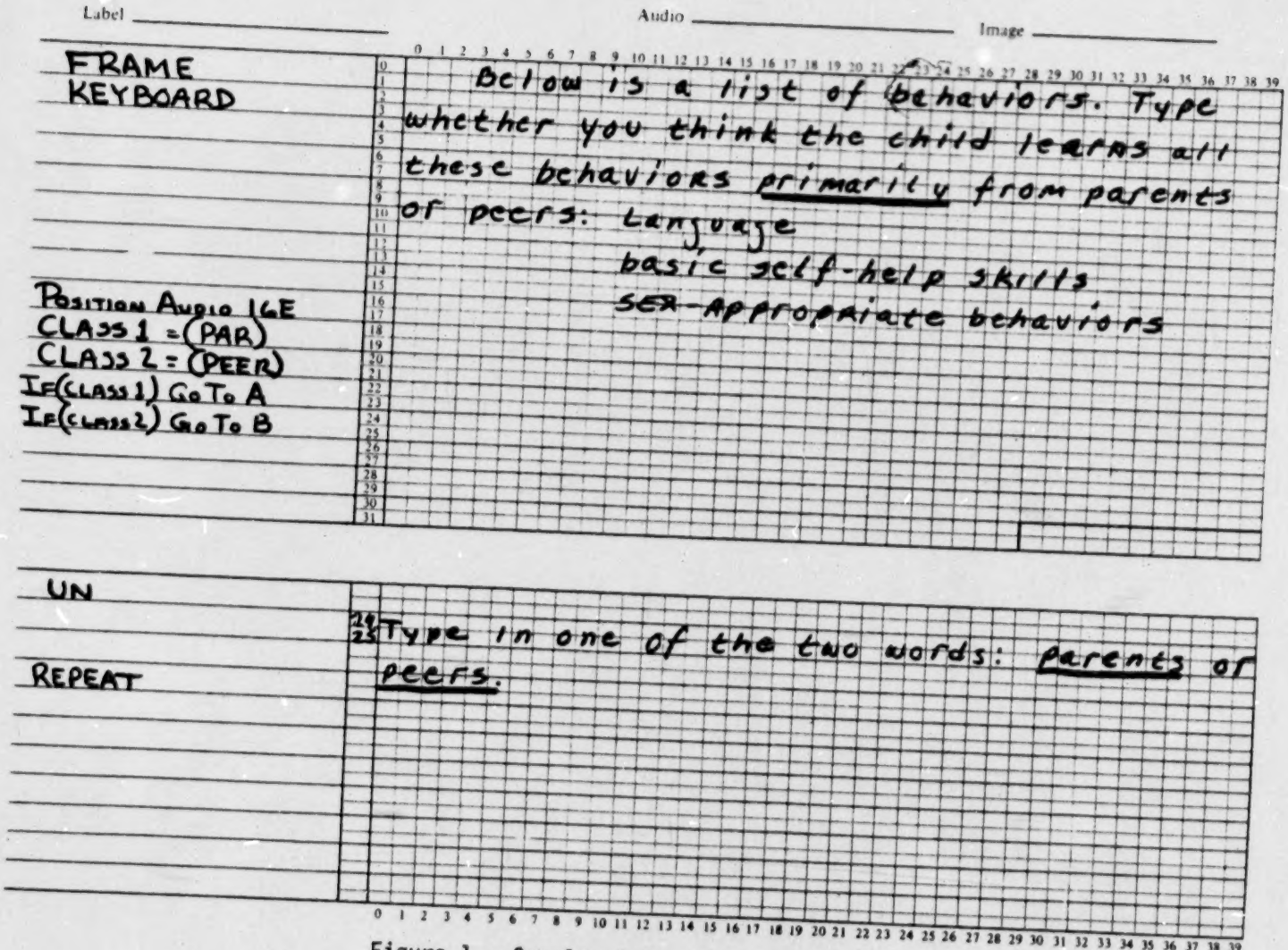
Label
Audio
Image
FRAME
KEYBOARD
Below is a list of behaviors. Type whether you think the child learns all these behaviors primarily from parents or peers: Language
basic self-help skills
SEX-Appropriate behaviors
POSITION AUDIO IGE
CLASS 1 = (PAR)
CLASS 2 = (PEER)
IF(CLASS 1) GO TO A
IF(CLASS 2) GO TO B
UN
REPEAT
Type in one of the two words: parents or peers.

Figure 1. Sample of the author's writing.

Label _____ Audio _____ Image _____

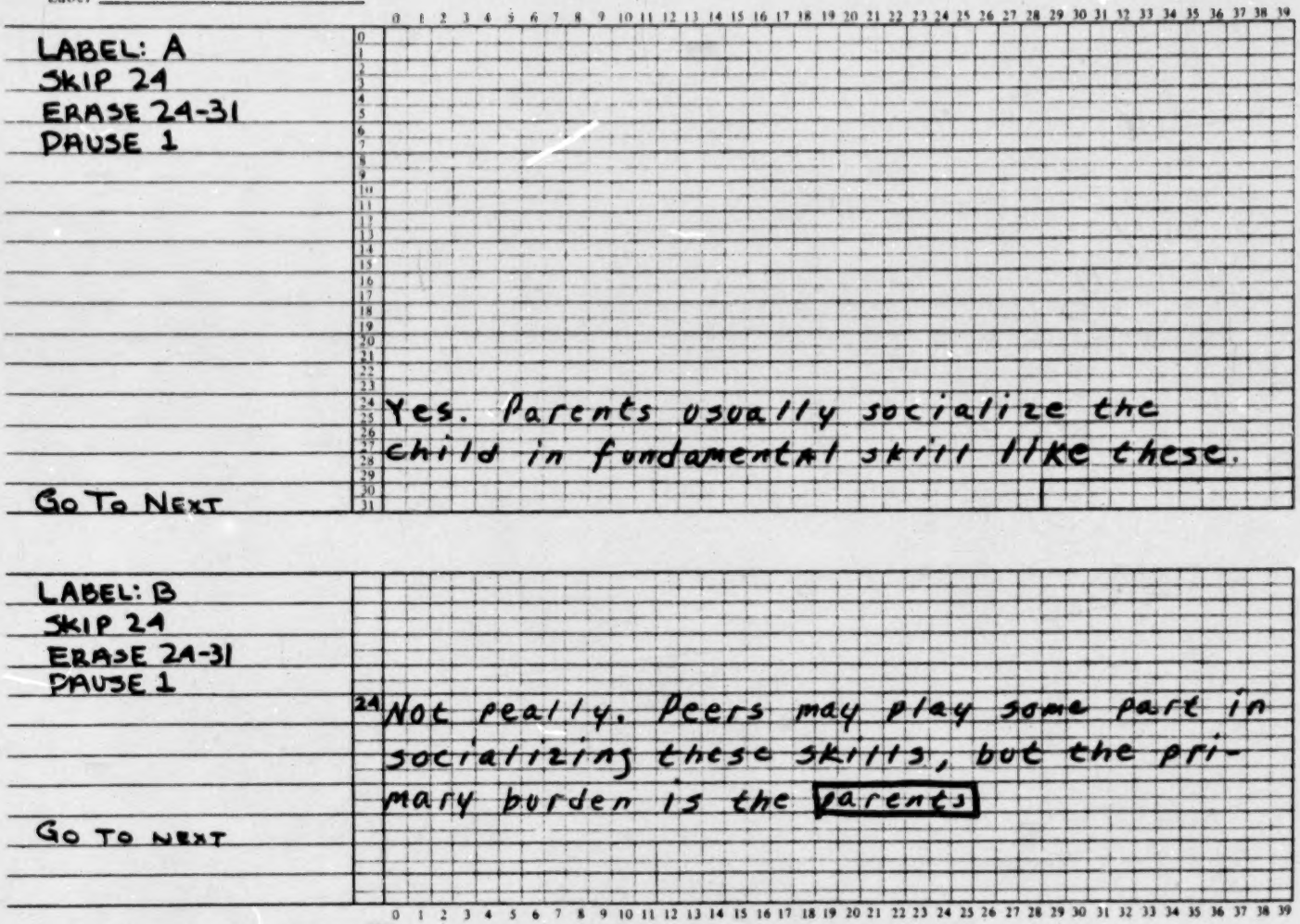
LABEL: A
SKIP 24
ERASE 24-31
PAUSE 1
Yes. Parents usually socialize the child in fundamental skill like these.
GO TO NEXT
LABEL: B
SKIP 24
ERASE 24-31
PAUSE 1
24 Not really. Peers may play some part in socializing these skills, but the primary burden is the parents
GO TO NEXT

Figure 1 - Con't.

```
STATEMENT      TACL                    EEG
NUMBER         CPCCCES                                  1         2         3
                                        01234567890123456789012345678901234567890   FRAME NO.   94

2057    .FRAME.

2058    .KEYBCARD                    00
2059                                 01    BELOW IS A LIST OF BEHAVIORS. TYPE
                                     02
2060                                 03
                                     04  WHETHER YOU THINK THE CHILD LEARNS ALL
                                     05
                                     06                          BBBBBBBB.........
2061                                 07  THESE BEHAVIORS PRIMARILY  --------- FROM PARENTS
                                     08
                                     09
2062                                 10  OR PEERS. LANGUAGE
                                     11
                                     12
2063                                 13        BASIC SELF-HELP SKILLS
                                     14
                                     15
2064                                 16        SEX-APPROPRIATE BEHAVIORS

2065    .POSITION AUDIO 16E

        . -----   ---
2066    . CLASS1=(PAR)

        . -----   ----
2067    . CLASS2=(PEER)

        .  -----  -----
2068    .IF(CLASS1)GOTOA

        .  -----  -----
2069    .IF(CLASS2)GOTOB

        .
2070    .LN
                                     17
                                     18
                                     19
                                     20
```

Figure 2. Coursewriter II program generated by TACL.

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```
                                                  21
                                                  22
                                                  23

2071    &SKIP 24                                  24  -                          .          BBBBBBB.......
2072                                              25  TYPE IN ONE OF THE TWO WORDS. PARENTS       ------- OR
                                                  26       BBBBB.....
2073                                              27  PEERS     -----.
        .
2074    &REPEAT
        .
2075    &LABEL  A
                                                  28
                                                  29
                                                  30
                                                  31
*****************************************************************************************************
        .
2076    &SKIP 24
        .
2077    &ERASE24- 31
        .
2078    &PAUSE01                                  24  -    -
2079                                              25  YES. PARENTS USUALLY SOCIALIZE THE
                                                  26
2080                                              27  CHILD IN FUNDAMENTAL SKILLS LIKE THESE.
        .     ----
2081    &GOTO NEXT
        .
2082    &LABEL  B
                                                  28
                                                  29
                                                  30
                                                  31
*****************************************************************************************************
```

Figure 2 - Con't.

```
2083    &SKIP 24

        .
2084    &ERASE24- 31

        .
2085    &PAUSE01                                24  - -       - - --
2086                                            25  NOT REALLY. PEERS MAY PLAY SOME PART IN
                                                26
2087                                            27  SOCIALIZING THESE SKILLS, BUT THE PRI-
                                                28                +++++++
2088                                            29  MARY BURDEN IS THE PARENTS.
        .    ----
2089    &GOTO NEXT

STATEMENT       TACL                EEG                 1         2         3
 NUMBER         OPCODES                     01234567890123456789012345678901234567890   FRAME NO.   95

        .
2090    &FRAME

        .
2091    &LIGHT PEN

        .
2092    &PLAY AUDIO 16E
                                            00
                                            01

        .
2093    &SKIP 02                            02          -----          .
2094                                        03          PEERS TEACH EACH OTHER.
        .
2095    &PAUSE03

        .
2096    &RESUME AUDIO
                                            04
```

Figure 2 - Con't.

```
3210  CB92
3211        1       DTI 30,36+/2,30+/4,36+/+S+P•E
3212        2       EPI 30,38+/2,30+/1,39+/+/1+/•E
3213        3       AA  (8+/)ZZ•E
3214        4       PR  •E
3215        5       DE  0+/32•E
3216        6       DTI 30,29+/2,30+/6,29+/CB92     •E
3217        7       FPO •E
3218        8       DT  4,0+/2,4+/40,0+/   (H)OW DOES SOCIALIZATION BRING ABOUT •E
3219        9       DT  7,0+/2,7+/40,0+/THIS CHANGE IN THE CHILD'S AWARENESS OF •E
3220       10       DT  10,0+/2,10+/40,0+/OTHER POINTS OF VIEW// •E
3221       11       PA  60•E
3222       12       FN  PSREMV+/  +/C(=)01,004L+,02+,T(=)492L+/C(=)01,005(+,04+,T(=)541L•E
3223       13       AUP CB15•E5864,1+/234•E
3224       14       DT  18,0+/2,18+/40,0+/   (T)HE ABILITY TO TAKE THE OTHER PER- •E
3225       15       DT  21,0+/2,21+/40,0+/SON'S POINT OF VIEW ALLOWS HUMAN BEINGS •E
3226       16       DT  24,0+/2,24+/40,0+/TO LIVE TOGETHER, WHICH IS THE ULTIMATE •E
3227       17       DT  27,0+/2,27+/40,0+/GOAL OF SOCIALIZATION.•E
3228  CB93
3229        1       DTI 30,36+/2,30+/4,36+/+S+P•E
3230        2       EPI 30,38+/2,30+/1,39+/+/1+/•E
3231        3       AA  (8+/)ZZ•E
3232        4       PR  •E
3233        5       DE  0+/32•E
3234        6       DTI 30,29+/2,30+/6,29+/CB93     •E
3235        7       DT  0,0+/2,0+/40,0+/   (O)KAY, SO SOCIETIES SET UP RULES•E
3236        8       DT  3,0+/2,3+/40,0+/FOR ACCEPTABLE BEHAVIOR AND CHILDREN•E
3237        9       DT  6,0+/2,6+/40,0+/LEARN THE PROPER BEHAVIOR FROM THE•E
3238       10       DT  9,0+/2,9+/40,0+/PEOPLE AROUND THEM. (B)UT WHO SPECIFI-•E
3239       11       DT  12,0+/2,12+/40,0+/CALLY IS RESPONSIBLE FOR SOCIALIZING•E
3240       12       DT  15,0+/2,15+/40,0+/THE CHILD(/•E
3241       13       DT  18,0+/2,18+/40,0+/   (I)N OUR SOCIETY THERE ARE TWO GROUPS•E
3242       14       DT  21,0+/2,21+/40,0+/OF PEOPLE WHO ACCOMPLISH MOST OF A•E
3243       15       DT  24,0+/2,24+/40,0+/CHILD'S SOCIALIZATION(& +P+A+R+E+N+T+S )AND +P+E+E+R+S•E
3244       16       DT  27,0+/2,27+/40,0+/(9)OTHER CHILDREN OF ABOUT THE SAME AGE(O). •E
3245  CB94
3246        1       DTI 30,36+/2,30+/4,36+/+S+P•E
3247        2       EPI 30,38+/2,30+/1,39+/+/1+/•E
3248        3       AA  (8+/)ZZ•E
3249        4       PRR •E
3250        5       BR  ON+/S31+/1•E
3251        6       DE  0+/32•E
3252        7       DTI 30,29+/2,30+/6,29+/CB94     •E
3253        8       DT  0,0+/2,0+/40,0+/   (B)ELOW IS A LIST OF BEHAVIORS. (T)YPE •E
```

Figure 3. TACL source listing (documentation).

```
CARE2-4     03/27/73

3254        9       DT  3,0+/2,3+/40,0+/WHETHER YOU THINK THE CHILD LEARNS ALL•E
3255       10       DT  6,0+/2,6+/40,0+/THESE BEHAVIORS PRIMARILY•B•B•B•B•B•B•B•B•B•B(--------- )FROM PARENTS•E
3256       11       DT  9,0+/2,9+/40,0+/OR PEERS(& )LANGUAGE•E
3257       12       DT  12,0+/2,12+/40,0+/          BASIC SELF-HELP SKILLS•E
3258       13       DT  15,0+/2,15+/40,0+/          SEX-APPROPRIATE BEHAVIORS •E
3259       14       AU  CB16•E5979•E
3260       15       EP  17,0+/2,17+/40,0+/+/40+/ CB94     •E
3261       16       FN  ED+/+/,D+/+/ +/,+/,+/(6+/)-+/(&+/)&+/(/+/)/+/•R+/•I+/•B+/•C•E
3262       17       AA  (8+/)ZZ•E
3263       18       LC  PAR +/B1•E
3264       19       FN2 COD+/),1•E
3265       20       FN2 SQ+/(A+/(99)1(00•E
3266       21       BR  CB94A•E
3267       22       AA  (8+/)ZZ•E
3268       23       LC  PEER  +/B1•E
3269       24       FN2 COD+/1,1•E
3270       25       FN2 SQ+/AB+/(99)1(00•E
3271       26       BR  CB94B•E
3272       27       UN  UA•E
3273       28       DT  24,0+/2,24+/40,0+/(T)YPE IN ONE OF THE TWO WORDS(& )PARENTS•B•B•B•B•B•B•B•B(-------- )OR•E
3274       29       DT  26,0+/2,26+/40,0+/PEERS•B•B•B•B•B•B(-----).•E
3275       30       BR  RE•E
3276       31       EA  •E
3277  CB94A
3278        1       DE  24+/6•E
3279        2       CTI 30,0+/2,30+/28,0+/•E
3280        3       PA  10•E
3281        4       CT  24,0+/2,24+/40,0+/(Y)ES. (P)ARENTS USUALLY SOCIALIZE THE•E
3282        5       CT  26,0+/2,26+/40,0+/CHILD IN FUNDAMENTAL SKILLS LIKE THESE. •E
3283        6       BR  CB95•E
3284  CB94B
3285        1       DE  24+/6•E
3286        2       CTI 30,0+/2,30+/28,0+/•E
3287        3       PA  10•E
3288        4       CT  24,0+/2,24+/40,0+/(N)OT REALLY. (P)EERS MAY PLAY SOME PART IN •E
3289        5       CT  26,0+/2,26+/40,0+/SOCIALIZING THESE SKILLS, BUT THE PRI-•E
3290        6       CT  28,0+/2,28+/40,0+/MARY BURDEN IS THE +P+A+R+E+N+T+S. •E
3291        7       BR  CB95•E
3292  CB95
3293        1       CTI 30,36+/2,30+/4,36+/+S+P•E
3294        2       EPI 30,38+/2,30+/1,39+/+/1+/•E
3295        3       AA  (8+/)ZZ•E
```

Figure 3 - Con't.

to newer systems is of greater value and importance than efforts to standardize procedures, languages, and facilities as some people often urge. CAI is too young and creative for standardizing and too important and compelling to ignore futures.

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